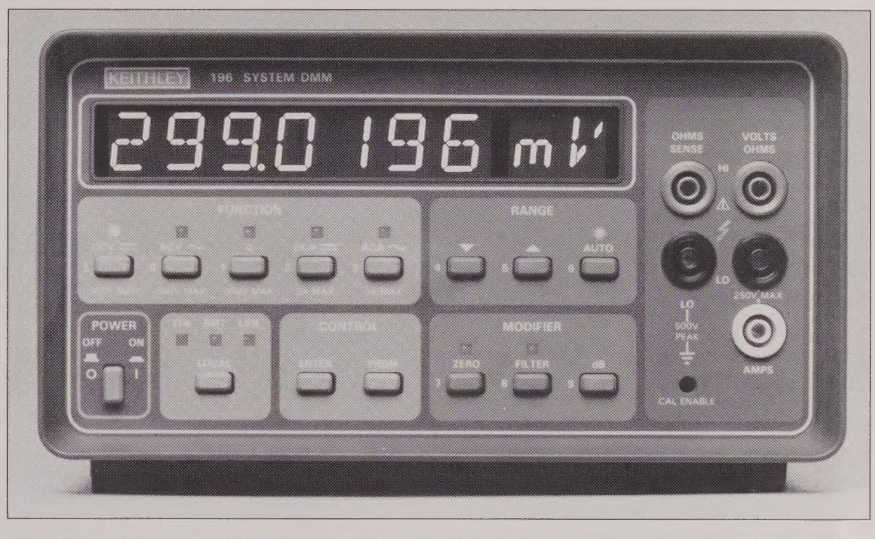
- **6½ digit resolution in V, Ω**
- **100nV, 100μΩ, 1nA sensitivities**
- **Up to 1000 readings/second**
- **Offset compensated Ω**
- **Non-volatile TRANSLATOR software**

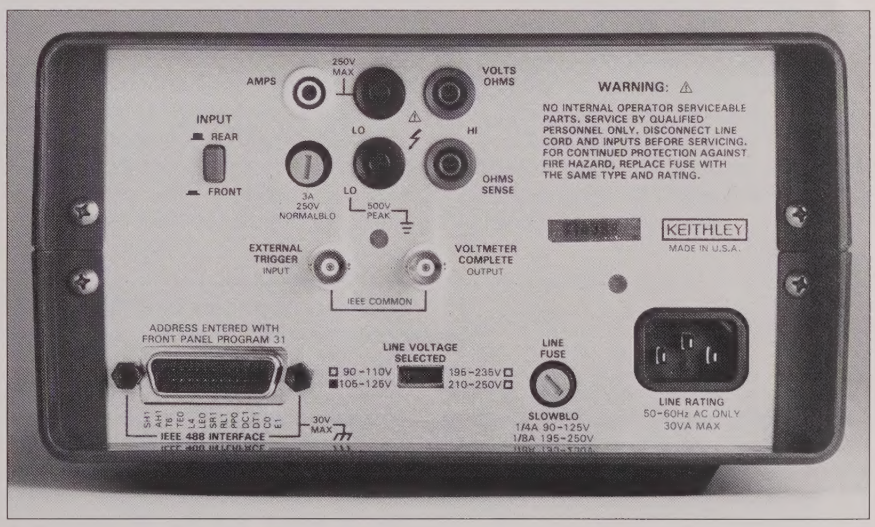
The fully IEEE-488 programmable Model 196 System DMM packages high resolution, high sensitivity, and high measurement speed into a compact half-rack enclosure. All five basic functions (dcV, acV, dcA, acA, and ohms) as well as programmability are standard.

Resolve 1/3 ppm. Whether you are developing and testing the next generation of components which have tighter tolerances and increased sensitivities, or you are researching a low level phenomenon, you need higher levels of both resolution and sensitivity in your DMM. The Model 196 meets your needs with a 6½-digit, 3,000,000 count display. At full scale the last digit represents a very small 1/3 ppm.

Detect 100nV, 100μΩ, and 1nA Changes. The 196 provides excellent sensitivity in not only voltage and resistance but also current. Combined with the 3,000,000 count display, you can, for example, resolve 1μV in 3 volts, 1mΩ in 3kΩ, and 10nA in 3mA. With 24-hour stability and linearity under 20ppm in dc volts, the small changes that the 196 detects are due to changes in your signal. The 196's excellent preformance extends beyond short term stability and good linearity. The basic 90-day dcV accuracy is as low as 30ppm.

Enhance Measurement Quality. Special features enable you to obtain the most from the 196's resolution and sensitivity. Eliminate thermal effects that can create errors in low level resistance measurements with a measurement technique called offset compensated ohms (see box). Control the user-programmable digital filtering levels to compensate for external noise. Eliminate offsets with the user-programmable ZERO function. In fact, independent zero and filter levels can be established for each function; the 196 stores these parameters separately.





Rear panel of Model 196 features front/rear input selection switch, external trigger input, voltmeter complete output, and IEEE-488 interface connector.

High Speed for High System Throughput. When speed is more critical than extracting maximum resolution and sensitivity, the 196 has the versatility to meet your needs. Capture low frequency phenomena of any waveshape with a measurement rate of 1000 readings/second at 3½-digit resolution. At 4½-digit resolution acquire 333 readings/second. In system applications the 196 can be triggered to take 200 readings/second at 3½ digits. When reading speeds exceed the rate at which they can be handled over the IEEE-488 bus, readings can be stored in the 196's 500-reading buffer.

Eases the System Integration Task. The 196 is fully programmable. Simplicity in programming and consistency in operation are inherent in Keithley's IEEE-488 implementation. And the IEEE-488 interface is built-in.

Keithley's exclusive TRANSLATOR software enables you to substitute your own mnemonics for the 196's device-dependent command strings. The mnemonics use fewer characters, making your code more readable and reducing bus activity. TRANSLATOR also provides emulation capability

which lets you upgrade your system by using the 196 to replace an older DMM without making major changes to the main body of your software. The TRANSLATOR commands are retained in non-volatile memory, so the 196 needs to be programmed only once.

Extended Capabilities Increase Applications

- High/Low/Pass limit testing for incoming inspection applications.
- AC dB measurements with programmable reference for amplifier stage gain analysis.
- mX + b scaling for converting readings into physical unit quantities.
- Front/rear inputs, with the position of the front/rear switch sensed over the bus, avoiding loss of data and time by verifying that the 196 is programmed for the correct inputs.
- Front panel menu display to enable access to all user programs without the aid of an operating guide.
- Digital calibration with a recessed front panel calibration enable switch which can be covered for calibration security.

Front Panel Programs	
0	Menu
2	Display Resolution
4	mX + b
5	Hi/Lo/Pass
6	Multiplex On/Off
30	Save Setup
31	IEEE-488 Address
32	Line Frequency
33	Self Test
34	Set m, B Constants
35	Set Hi/Lo Limits
36	Digital Calibration
37	Reset to factory default conditions
Ω	Offset Compensation
ZERO	Zero Modify
FILTER	Filter Constants
dB	dB Reference

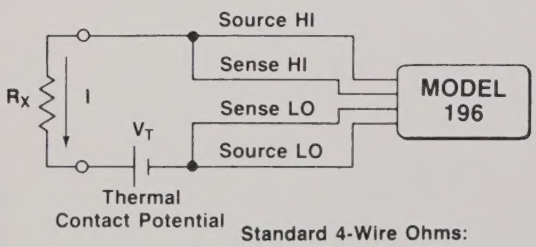
Full-Rack System Performance in a Half-Rack Package. Only Keithley offers this much performance in a bench/system DMM. Coupled with a Model 705 Scanner, the 196 becomes a low-cost multi-channel testing system. In addition, the 196 integrates well with the full line of Keithley programmable sourcing, switching, and measurement instruments.

Eliminate Errors in Low Resistance Measurements with Offset Compensated Ohms

Lead resistance and thermal contact potentials create errors in low resistance measurements. Lead resistance errors are eliminated by standard 4-wire measurement techniques.

The Model 196 offset compensated ohms capability now eliminates the last major error term in your external circuit. This is accomplished by a 2-step measurement process where the terminal voltage is measured without current through the unknown resistance. This is a direct measure of the thermal contact potential in the circuit, and the error from this potential is subtracted from the final result.

MEASUREMENT CIRCUIT

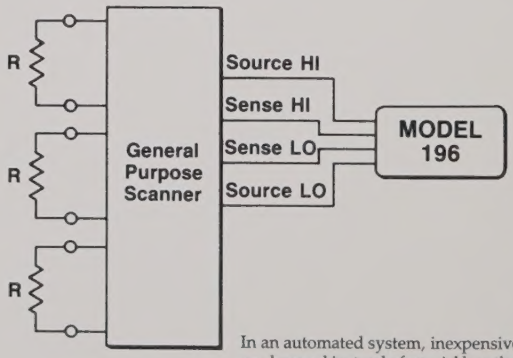


Standard 4-Wire Ohms:

$$R = \frac{IR_X + V_T}{I} \qquad \text{Error} = \frac{V_T}{I}$$

Offset Compensated Ohms:

$$R = \frac{(IR_X + V_T) - V_T}{I}$$



In an automated system, inexpensive relay switching can be used instead of special low thermal relays. The 196 can compensate for the thermal voltages generated by general purpose relay contacts.

DC VOLTS
(6½ Digits)

RANGE	RESOLUTION	INPUT RESISTANCE	ACCURACY[1] ±(%rdg + counts) 24 Hr.,[2] 23° ±1°C	90 Days, 18°-28°C	1 Year, 18°-28°C	TEMPERATURE COEFFICIENT ±(%rdg + counts)/°C 0°-18° & 28°-50°C
300 mV	100 nV	>1 GΩ	0.0020 + 20[3]	0.005 + 20[3]	0.008 + 20[3]	0.0006 + 10
3 V	1 μV	>1 GΩ	0.0013 + 10	0.003 + 20	0.0038 + 20	0.0004 + 1
30 V	10 μV	11 MΩ	0.0015 + 10	0.006 + 20	0.008 + 30	0.0013 + 3
300 V	100 μV	10.1 MΩ	0.003 + 10	0.009 + 20	0.009 + 30	0.0013 + 1

[1]For 5½-digit accuracy, divide count error by 10. For 4½-digit accuracy, count error is 5 (except 15 on 300mV range). For 3½-digit accuracy, count error is 5.
[2]Relative to calibration standards.
[3]When properly zeroed.

ANALOG SETTLING TIME: <1ms (<2ms on 300mV range), to 0.01% of step change.

CMRR: >120dB at dc, 50Hz or 60Hz (±0.05%) with 1kΩ in either lead.

NMRR: >60dB at 50Hz or 60Hz (±0.05%).

LINEARITY: Linearity is defined as the maximum deviation from a straight line between the readings at zero and full range: 10ppm of range for 3V-300V ranges; 15ppm of range for 300mV range; at 23°C ±1°C.

MAXIMUM ALLOWABLE INPUT: 300V rms, 425V peak, whichever is less.

TRMS AC VOLTS
(5½ Digits)

RANGE	RESOLUTION	ACCURACY[1] ±(%rdg + counts) 1 Year, 18°-28°C 20Hz-50Hz[2]	50Hz-200Hz[2]	200Hz-10kHz[2]	10kHz-20kHz[2]	20kHz-100kHz[3]
300 mV	1 μV	2 + 100	0.3 + 100	0.15 + 100	0.4 + 200	2.0 + 300
3 V	10 μV	2 + 100	0.3 + 100	0.15 + 100	0.3 + 200	1.5 + 300
30 V	100 μV	2 + 100	0.3 + 100	0.15 + 100	0.4 + 200	1.5 + 300
300 V	1 mV	2 + 100	0.3 + 100	0.15 + 100	0.4 + 200	1.5 + 300

[1]For 4½-digit accuracy, divide count error by 10. For 3½-digit accuracy, count error is 5. In 3½- and 4½-digit modes, specifications apply for inputs >200Hz.
[2]For sinewave inputs >2,000 counts.
[3]For sinewave inputs >20,000 counts.

RESPONSE: True root mean square, ac coupled.

CREST FACTOR (ratio of peak to rms): Up to 3:1 allowable.

NONSINUSOIDAL INPUTS: For fundamental frequencies <1kHz, crest factor <3, add 0.25% of reading to specified accuracy for 300mV and 3V ranges; add 0.6% of reading to specified accuracy for 30V and 300V ranges.

INPUT IMPEDANCE: 1MΩ shunted by <120pF.

3dB BANDWIDTH: 300kHz typical.

MAXIMUM ALLOWABLE INPUT: 300V rms, 425V peak, 10^7 V·Hz, whichever is less.

SETTLING TIME: 1 second to within 0.1% of change in reading.

TEMPERATURE COEFFICIENT (0°-18°C & 28°-50°C): <±(0.1 × applicable accuracy specification)/°C below 20kHz, ±(0.2x) for 20kHz to 100kHz.

CMRR: >60dB at 50Hz or 60Hz (±0.05%) with 1kΩ in either lead.

dB (Ref. = 1V):

INPUT	ACCURACY ±dB 1 Year, 18°-28°C 20Hz-20kHz	20kHz-100kHz	RESOLUTION
−34 to +49 dB (20mV to 300V)	0.2	0.4	0.01 dB
−54 to −34 dB (2mV to 20mV)	1.1	3[1]	0.01 dB

[1]Typical.

OHMS
(6½ Digits)

RANGE	RESOLUTION	NOMINAL I-SHORT	ACCURACY[1] ±(%rdg + counts) 24 Hr.,[5] 23° ±1°C	90 Days, 18°-28°C	1 Year, 18°-28°C	TEMPERATURE COEFFICIENT ±(%rdg + counts)/°C 0°-18° & 28°-50°C
300 Ω[2]	100 μΩ	1.7 mA	0.0025 + 20[3]	0.008 + 20[3]	0.010 + 20[3]	0.001 + 7
3 kΩ[2]	1 mΩ	1.7 mA	0.0025 + 20	0.005 + 20	0.007 + 20	0.001 + 1
30 kΩ[2]	10 mΩ	160 μA	0.0025 + 20	0.005 + 20	0.007 + 20	0.001 + 1
300 kΩ	100 mΩ	50 μA	0.006 + 20	0.020 + 20	0.021 + 20	0.004 + 1
3 MΩ	1 Ω	5 μA	0.007 + 20	0.020 + 20	0.021 + 20	0.004 + 1
30 MΩ	10 Ω	0.5 μA	0.06 + 50	0.1 + 50	0.1 + 50	0.030 + 1
300 MΩ[4]	1 kΩ	0.5 μA	2.0 + 5	2.0 + 5	2.0 + 5	0.30 + 1

[1]For 5½-digit accuracy, divide count error by 10. For 4½-digit accuracy, count error is 5 (except 15 on 300Ω range). For 3½-digit accuracy, count error is 5.
[2]4-wire accuracy, 300Ω-30kΩ ranges.
[3]When properly zeroed.
[4]Resolution on 300MΩ range is limited to 5½ digits.
[5]Relative to calibration standards.

CONFIGURATION: Automatic 2- or 4-wire. Offset compensation available on 300Ω-30kΩ ranges, requires proper zeroing. Allowable compensation of ±10mV on 300Ω range and ±100mV on 3kΩ and 30kΩ ranges.

MAX. ALLOWABLE INPUT: 300V rms, 425V peak, whichever is less.

OPEN CIRCUIT VOLTAGE: 5.5V maximum.

LINEARITY: Linearity is defined as the maximum deviation from a straight line between the readings at zero and full range: 20ppm of range for 300Ω-30kΩ ranges, at 23°C ±1°C.

IEEE-488 BUS IMPLEMENTATION

MULTILINE COMMANDS: DCL, LLO, SDC, GET, GTL, UNT, UNL, SPE, SPD.

UNILINE COMMANDS: IFC, REN, EOI, SRQ, ATN.

INTERFACE FUNCTIONS: SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0, E1.

PROGRAMMABLE PARAMETERS: Range, Function, Zero, Integration Period, Filter, EOI, Trigger, Terminator, Delay, 500-Reading Storage, Calibration, Display, Multiplex, Status, Service Request, Self Test, Output Format, TRANSLATOR.

DC AMPS

(5½ Digits)

RANGE	RESOLUTION	ACCURACY[1] ±(%rdg + counts) 1 Year, 18°-28°C	MAXIMUM VOLTAGE BURDEN
300 μA	1 nA	0.09 + 20	0.4 V
3 mA	10 nA	0.05 + 10	0.4 V
30 mA	100 nA	0.05 + 10	0.4 V
300 mA	1 μA	0.05 + 10	0.5 V
3 A	10 μA	0.09 + 10	2 V

[1]4½-digit count error is 20. 3½-digit count error is 5.

MAXIMUM ALLOWABLE INPUT: 3A, 250V.

OVERLOAD PROTECTION: 3A fuse (250V), accessible from rear panel.

TEMPERATURE COEFFICIENT (0°-18°C & 28°-50°C): < ±(0.1 × applicable accuracy specification)/°C.

TRMS AC AMPS

(5½ Digits)

RANGE	RESOLUTION	ACCURACY[1] 1 Year, 18°-28°C 20Hz-45Hz	45Hz-10kHz	MAXIMUM VOLTAGE BURDEN
300 μA	1 nA	2 + 100	0.9 + 100	0.4V
3 mA	10 nA	2 + 100	0.6 + 100	0.4V
30 mA	100 nA	2 + 100	0.6 + 100	0.4V
300 mA	1 μA	2 + 100	0.6 + 100	0.5V
3 A	10 μA	2 + 100	0.6 + 100	2 V

[1] For sinewave inputs >2000 counts. For 4½-digit accuracy, divide count error by 10. For 3½-digit accuracy, count error is 5. In 3½- and 4½-digit modes, specifications apply for sinewave inputs >200Hz.

RESPONSE: True root mean square, ac coupled.

CREST FACTOR (ratio of peak to rms): Up to 3:1 allowable at ⅔ full scale.

NONSINUSOIDAL INPUTS: Specified accuracy for fundamental frequencies <1kHz, crest factor <3.

SETTLING TIME: 1 second to within 0.1% of change in reading.

MAXIMUM ALLOWABLE INPUT: 3A, 250V.

OVERLOAD PROTECTION: 3A fuse (250V) accessible from rear panel.

TEMPERATURE COEFFICIENT (0°-18°C & 28°-50°C): < ±(0.1 × applicable accuracy specification)/°C.

dB (Ref. = 1mA):

INPUT	ACCURACY ±dB 1 Year, 18°-28°C 20Hz-10kHz	RESOLUTION
−34 to +69 dB (20μA to 3A)	0.2	0.01 dB
−54 to −34 dB (2μA to 20μA)	0.9	0.01 dB

MAXIMUM READING RATES[1]

DCV, DCA, ACV, ACA READINGS/SECOND

RESOLUTION	Continuous into Internal Buffer MUX: Off	On	External Trigger into Internal Buffer MUX: Off	On	Triggered via IEEE-488 Bus MUX: Off	On
3½-Digit	1000	1000	237	80	112	58
4½-Digit	333	333	145	63	91	49
5½-Digit	35 (29)	9 (7.5)	40 (33)	9 (7.5)	35 (29)	9 (7.5)
6½-Digit[2]		9 (7.5)		0.3 (0.25)		0.3 (0.25)

OHMS READINGS/SECOND

RESOLUTION	Continuous into Internal Buffer MUX: Off	On	External Trigger into Internal Buffer MUX: Off	On	Triggered via IEEE-488 Bus MUX: Off	On
3½-Digit	53	25	57	25	37	23
4½-Digit	43	20	47	21	30	19
5½-Digit	16 (13)	9.5 (7.5)	18 (15)	9.5 (7.5)	15 (12.5)	9.5 (7.5)
6½-Digit[2]		9 (7.5)		0.3 (0.25)		0.3 (0.25)

Offset Compensated Ohms: Rates are 0.5× normal mux on ohms rates.

[1]Reading rates are for on-range on-scale readings with internal filter off, for 3V, 3kΩ, and 3mA ranges. 6½- and 5½-digit rates are for 60Hz operation. Values in parentheses are for 50Hz operation.

[2]Internal filter on.

GENERAL

RANGING: Manual or autoranging.

MAXIMUM READING: 3029999 counts in 6½-digit mode.

ZERO: Control subtracts on-scale value from subsequent readings or allows value to be programmed.

CONNECTORS: Analog: Switch selectable front or rear, safety jacks. **Digital:** TRIGGER input and VOLTMETER COMPLETE output on rear panel, BNCs.

WARMUP: 2 hours to rated accuracy.

DISPLAY: 10, 0.5-in. alphanumeric LED digits with decimal point and polarity. Function and IEEE-488 bus status also indicated.

ISOLATION: Input Lo to IEEE Lo or power line ground: 500V peak. 5×10^8 max. V·Hz product. $>10^9\Omega$ paralleled by 400pF.

DATA MEMORY: 1 to 500 locations, programmable. Measurement intervals selectable from 1ms to 999999ms or triggered.

BENCH READING RATE: 5 readings/second (2/second on 30MΩ and 300MΩ ranges).

FILTER: Weighted average (exponential). Programmable weighting, 1 to 1/99.

OPERATING ENVIRONMENT: 0°-50°C, 0%-80% relative humidity up to 35°C; linearly derate 3% RH/°C, 35°C-50°C (0%-60% RH up to 28°C on 300MΩ range).

STORAGE ENVIRONMENT: −25° to +65°C.

POWER: 105-125V or 210-250V, rear panel switch selected, 50Hz or 60Hz, 30VA max. 90-110V and 180-220V versions available upon request.

DIMENSIONS, WEIGHT: 127mm high × 216mm wide × 359mm deep (5 in. × 8½ in. × 14⅛ in.). Net weight 3.7kg (8 lbs.).

ACCESSORIES AVAILABLE:

Model 1019A-1: 5¼-in. Single Fixed Rack Mounting Kit
Model 1019A-2: 5¼-in. Dual Fixed Rack Mounting Kit
Model 1019S-1: 5¼-in. Single Slide Rack Mounting Kit
Model 1019S-2: 5¼-in. Dual Slide Rack Mounting Kit
Model 1651: 50-Ampere Shunt
Model 1681: Clip-On Test Lead Set
Model 1682A: RF Probe
Model 1685: Clamp-On Current Probe
Model 1751: General Purpose Test Leads
Model 1754: Universal Test Lead Kit
Model 5806: Kelvin Clip Leads
Model 7007-1: Shielded IEEE-488 Cable, 1m
Model 7007-2: Shielded IEEE-488 Cable, 2m
Model 7008-3: IEEE-488 Cable, 3 ft. (0.9m)
Model 7008-6: IEEE-488 Cable, 6 ft. (1.8m)

Prices and specifications subject to change without notice.

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